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ABSTRACT

Two different control groups were used to evaluate the use of pre- and post-test examination questions presented in the format of a Navy training film. The control group was given a paper-and-pencil pre- and post-test while the experimental group received the pre- and post-test questions within the context and format of the film. While no significant differences were revealed between the two groups or the two methods of testing, it was found that learning gains attributed to the use of the training film were quite outstanding when comparing student pre- and post-test differences. (MV)

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CNET SUPPORT REPORT 4-76

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TEST AND EVALUATION OF CRITERION TESTING IN THE FORMAT OF DISCRETE MOTION PICTURES

(CNET SUPPORT FIELD TASK NUMBER 50323-21-OR-66)

Prepared for
The Chief of Naval Education and Training Support

by

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1. CNETS Study Report 4-76, "Test and Evaluation of Criterion Testing in the Format of Discrete Motion Pictures, is promulgated for information.

2. The conclusions and recommendations contained in the report are those of the author and are not necessarily those of the Chief of Naval Education and Training Support.

3. This publication has been reviewed under the provisions of SECNAVINST 5600.16 and is approved.

Wayne P. Hughes, Jr.

WAYNE P. HUGHES, JR.

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1.0 Summary. Criterion testing in the format of a Discrete Motion Picture--Oxygen Breathing Apparatus, OBA Film MN 31169--was tested and evaluated. Two different recruit groups, Control I and Experimental II were used to test and evaluate the use of pre- and post-test examination questions presented in the format of a Navy training film. The Control group and the Experimental group were sub-divided into three sections. Control Group I included sections A, B, C, and the Experimental Group II included sections D, E, F. Each section in each group was scheduled individually to participate in the study/evaluation procedure. The Control group members were given a printed (paper and pencil) pre- and post-test while the Experimental group members were administered the same pre- and post-test questions by means of motion picture film.

The results of the study revealed no significant differences in test scores between the two groups and/or the two methods of testing (paper vs film) which can be accounted for. A serendipitous finding, however, revealed that learning gains, made by using a structured instructional film, were quite outstanding when comparing student pre- and post-test differences. Recommendations suggest that the Navy can judiciously prepare film type training packages for various informal training environments (OBT, GMT) and expect practically the same results in group paced training situations without the

facilities and manpower required in the formal instructional situation. The economic data resulting from this study would tend to discourage a major shift to total instructional testing by film in the Navy Discrete Motion Picture MN Film series.

2.0 Acknowledgements. This CNET SUPPORT task could not have been completed without the cooperation of the Recruit Training Command at NTC San Diego, CA and especially LCDR Gary L. JOHNSON, (since transferred). Special appreciation is also extended to NAVEDTRASUPPCENPAC and the Training Analysis and Evaluation Department personnel including Mr. Leonard Auguiar, Dr. J. Scott Newcomb, and Ms. Sandra Drummer who tested the subjects, organized the data, and provided the statistical summary. The services of Ms. Helen Bennett and Messrs. Lloyd Jordan, William K. Treynor, Art Crevensten, and Robert Myers of the NAVTRAEQUIPCEN, Orlando, FL are gratefully acknowleged. Their efforts produced the required art work and the instructional users guide for the experimental phase of this study. Special note is offered to Messrs. Robert Walcher, Gene Doubleday, and Zane G. Crockett of NAVINSTECHDEVCEN, San Diego, CA for their technical assistance and expertise in modifying the experimental film. Appreciation is also extended to Miss Teresa Hindman for her careful preparation of the final document.

3.0 Purpose. This report presents the results of CNET SUPPORT Plan # 157 A 14Z 1C 045 entitled A Proposed Plan To Incorporate Criterion Testing In The Format Of Discrete Motion Pictures. The purpose of this plan was to test, evaluate, and if successful, legislate the specifications to implement the idea of

incorporating criterion testing in the format of all discrete motion pictures produced for Navy training.

4.0 Background. This task originated as a result of CNET SUPPORT staff units working to develop specifications for use in the production of Naval Training Discrete Motion Pictures, e.g. Navy Film MN 11369, Operation and Use of Emergency Oxygen Breathing Apparatus (OBA). To this point, no one has reported hard data relative to the effectiveness and economy of testing students by using filmed questions versus the printed page. Until now, questions such as those which follow have remained unanswered.

* Would there be any significant difference in student scores by testing students through the medium of film projected test questions compared to using the printed questionnaire?

* Would there be a cost avoidance by eliminating printed pre- and post-test questionnaires?

* Would there be any distinct advantage in terms of production costs when comparing film to the printed page, etc.?

To this end a special edition of Navy film MN-11369 was developed and a plan was devised to determine the answers to these questions. Film revision was performed in-house and included only the addition of the OBA training film criterion test questions used in a previous study which measured the Training Effectiveness of Films Developed Using Systems Approach to Training Principles (CNETS Report 4-75 refers). The film scenarios

in the previous training package had been designed around an established set of specific behavioral objectives (SBOs), thus, the instructional goals of the film were structured and the test measures were developed and printed accordingly. The study reported here would eliminate the printed (paper) questionnaire. The findings, as described in paragraph 6.0 and Tables 2-7, were submitted in NAVEDTRASUPPCENPAC letters N1:LMA:JSN:SKD:SA 1500 Ser 829 of 3 May 1976 and N1:JSN:LMP 1500 Ser 1286 of 24 August 1976.

5.0 Methods. Information regarding the subjects involved in this study along with the testing procedures and the statistical analysis used to bring this study to a conclusion are presented here.

5.1 Subjects. Two different groups of subjects were used in this evaluation. One group was identified as Control Group #1 and one as Experimental Group #II. Both groups were divided into three sections of at least 30 persons per section. In reality, a total of 192 persons participated in this study. Ninety two served in the Control group and one hundred served with the Experimental group. Both groups were exposed to the same pre- and post-test questions concerning the Operation and Use of Emergency Breathing Apparatus Type A-three; however, only the Experimental group was given the pre- and post-test by means of the modified training film itself. Table 1 presents a summary of the groups and individual sections used in this study. As the table shows, the two groups involved in this

study were recruits in basic training at the Naval Recruit Training Command, San Diego, CA. None of the recruits involved in this study had had formal or informal Navy training in the operation or use of the oxygen breathing apparatus. The Control group viewed the standard Navy Training OBA film MN-31169 and received both the pre- and post- criterion tests by traditional pencil and paper means.

5.2 Testing Procedures. As mentioned above in paragraph 5.1, the OBA film was technically modified in order to incorporate the pre- and post- criterion test questions in the format of the film. The film scenarios depicting the desired SBO's to be learned were not changed. Both study groups observed the same film content and responded to the same test questions in both the pre- and post-tests. The test questions had been previously (CNETS Report 4-75 refers) designed to measure individual learning based upon pre-established SBO's as developed through the use of the Systems Approach to Training (SAT) procedures.

In keeping with SAT principles, pre- and post-testing questionnaires and test administration procedures were built into the film. The pre-test, which was administered to the Control group prior to viewing the film content, measured the entrance level knowledge of the subjects. The post-test was administered following the film in order to measure individual SBO achievement by each of the subjects. A list of the test items for the OBA film MN 31169 is presented in Appendix A. The multiple answer test items were recorded by the subjects

on a standard optical scan test answer sheet number SN-0106-017-0400. Prior to the showing of the OBA experimental film each study section was given explicit instructions relative to the use of the testing materials. In the case of Experimental Group II, only one optical scan test answer sheet was distributed prior to viewing the film. Both the pre- and post-test answers were recorded on the one answer sheet by utilizing the reverse side; however, both the pre- and post-test questions were read from the viewing screen rather than from the printed page.

5.3 Study Procedures. The recruit subjects were randomly selected and arbitrarily placed into two groups. These groups were further sub-divided into three sections which produced a total of six sections. This division is illustrated in Table 1.

5.3.1 Facilities. Both phases (Control and Experimental) of this study were conducted in an appropriate room equipped with student desks, a portable movie screen, one 16mm sound movie projector, an appropriate supply of multiple choice "op scan" test answer forms and No. 2 pencils.

5.3.2 Testing. The testing phase of this study was administered to each of the sections in Groups I and II on an individually scheduled basis. The testing plan for this study is also illustrated graphically in Table 1.

5.4 Statistical Analysis. Comparisons between groups were made using t-tests (t .05=1.98) adjusted for unequal variances. As a consequence of finding the pre-test Control group and Experimental group variances to be heterogeneous, the Cochran and Cox method was used to test the difference between pre-test means.[1] Tables 2 and 3 summarize those data and present the t-test results. Because Table 5 shows the post-test Control and Experimental group frequency distributions to be somewhat negatively skewed, a nonparametric .05 level test of the difference between the medians of these two groups was conducted. The results are reported in Table 6.

5.5 Cost Analysis. One important outcome of this study resulted in a comprehensive comparison of media production costs. The data presented in this study were arrived at by obtaining 1976 cost estimates for black and white film footage production and by formulating the assumptions which follow:

Assumptions:

1. Twenty five (25) prints of the OBA training film will be modified to include the required criterion test questions as used in this study.

2. Each reproduction (print) of this film will be used one time per week for fifty (50) weeks and viewed by 15 persons at each showing.

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[1] Ferguson, George A., 1966 Statistical Analysis in Psychology and Education, 2d ed. New York: McGraw-Hill Book Company, pg. 171.

3. The life expectancy of a print is three years.

4. Each paper test would require two (2) sheets of paper at a cost of 5¢ each.

5. The same answer sheet will be used in either test case.

6. The film will be retained by the user for one year.

7. Test sheets will require replacement at least once per quarter.

Analyzing media production costs to add the pre- and post-test to an MN training film similar to the one used for this study produced the costs which follow:

- 25 prints - $1131
- 50 prints - $1618
- 100 prints - $2407
- 200 prints - $4201
- 300 prints - $6020

Film costs per print, excluding the lifetime maintenance cost, is $45.24 compared to a paper cost of $18.00.*

6.0 Results

6.1 Statistical Tests. Based on the data contained in Tables 2-6 the results of the subject study are as follows:

- At the .05 level of significance there appears to be no difference in test scores between student groups that can be accounted for in the mode testing--paper or film.
- The nonparametric .05 level test relative to the negatively skewed post-test frequency distributions in Table 5 supports the parametric finding reported above.

6.2 Cost Evaluation. Although the mode of testing appears to make no difference in student test results, economic analysis

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* Based upon film cost estimates provided by Mr. William Treynor, NAVTRAEQUIPCEN, Autovon 791-4714.

of relative production costs to incorporate criterion measure test questions in training film formats tend to be prohibitive and favor paper (printed questionnaires) as the more cost efficient method to be used.

7.0 Discussion. Concrete data points to the fact that there is no significant difference in student test score results when questions are delivered by film or the printed page. Although the data in this study does not support the hypothesis that testing by film would be more advantageous from the standpoint of training effectiveness and testing production costs, a serendipitious finding has been noted. Table 7 supports previous findings in CNETS Report 4-75 Training Effectiveness of Films Developed Using Systems Approach to Training Principles that post-test comparisons of the experimental and control groups showed that structured training films employing the systems approach to training (SAT) significantly improved learning gains in both groups. This finding becomes significant to the training community in that both the control and experimental groups represented a heterogeneous whole who met or surpassed the minimum Naval recruiting standards for enlisted personnel. As there is no significant difference in test scores between groups exposed to the group mode of learning and testing (film versus paper and pencil questionnaire) the serendipity observed above suggests that required Naval training/learning can possibly be given to heterogeneous groups under various environmental conditions--sans the formal classroom--and during periods of scheduled and unscheduled

inactivity, i.e. during holding periods between assignments on shore or at sea. General Military Training (GMT) and certain onboard training (OBT) courses would be appropriate for this mode of instruction provided the subject film is designed within the parameters of SAT. Production costs notwithstanding serious deliberations should be given to the type media and the mode of delivery when GMT and OBT training courses are being planned or revised.

8.0 Conclusions. The following conclusions are made from the results reported above:

8.1 Although recruits in the control group posted slightly higher test scores when post-tested with the printed questionnaire than recruits in the experimental group who experienced the same test by viewing filmed questions, there was no significant difference established in the statistical data to bring about or suggest a major modification of existing criterion testing procedures and/or technique.

8.2 Pre-test knowledge of the subject in both the control and the experimental groups involved in this study did not appear to modify or influence post-test achievement by either group.

8.3 Criterion test production costs for printed questionnaires are appreciably less than those costs required to produce the same number of questions in a training film; however, the findings in this study suggest that initial increased production costs may be offset in terms of a cost benefit if the same amount of learning can take place in large group-paced

training situations involving required MN films and GMT, OBT types of courses.

8.4 Although film costs would discourage the development of a complete new series of MN training films which incorporate criterion test questionnaires, a serendipitous observation in this study indicates that learning achievements in both groups are, indeed, quite outstanding. The impact of this fact on future development and design of training films in the MN series, GMT, and OBT areas suggests the continued use of SAT procedures when film is chosen as the instructional training media.

9.0 Recommendations

9.1 The NAVEDTRACOM should continue to use printed pre- and post-test questionnaires as required by the Discrete Motion Picture MN film series; however, curricula developers should not limit future training film criterion test production to the printed page if the subject matter of the training is such that it can be delivered in the group paced mode under environmental conditions unlike the formal classroom.

9.2 The findings of this study suggest that it may be both practical and cost effective to offer personnel shipboard orientation training programs related to required shipboard duties involving team type activities, i.e. damage control, firefighting, use of oxygen breathing apparatus, etc., as well as selected GMT and OBT types of courses while in an

enforced/inactive duty mode awaiting shipboard duty or transfer to another duty station. It is, therefore, recommended that an effort be made to initiate a feasibility study to determine the efficiency of this hypothesis by using training films similar to the film used in this study.

TABLE 1

SUMMARY OF STUDY DESIGN

Group	Section	Group Composition	Film Viewed	Test Taken	Type Test	Pre-Test	Post-Test
Control #1	A	Recruits	OBA Film MN-31169	Pre/Post	Pencil / Paper Questionnaire	30	30
Control #1	B	Recruits	OBA Film MN-31169	Pre/Post	Pencil / Paper Questionnaire	30	30
Control #1	C	Recruits	OBA Film MN-31169	Pre/Post	Pencil / Paper Questionnaire	30	30
Subtotal						92	92
Experimental #II	D	Recruits	OBA Film MN-31169 (Modified) *	Pre/Post	Filmed Questionnaire	34	34
Experimental #II	E	Recruits	OBA Film MN-31169 (Modified) *	Pre/Post	Filmed Questionnaire	34	34
Experimental #II	F	Recruits	OBA Film MN-31169 (Modified) *	Pre/Post	Filmed Questionnaire	32	32
Subtotal						100	100
Test Total No. Recruits						192	192

* Navy Film MN-31169 Modified to include pre- and post-criterion test questions. Subjects recorded answers to filmed questions on paper answer sheets.

TABLE 2

DATA SUMMARY

Pre-Test/Post-Test Means

Group	Pre-Test Mean	Post-Test Mean	N
Control I			
A	3.47	10.23	30
B	3.53	9.70	30
C	3.28	10.75	32
Experimental II			
D	3.27	9.53	34
E	3.15	9.56	34
F	3.44	9.63	32

TABLE 3

t Test Results

Pre-Test

Group	N	Mean	SD	SEM	SED	*t**
Control #1	92	3.42	1.79	.33	.24	.58
Experimental #II	100	3.28	1.47	.12		

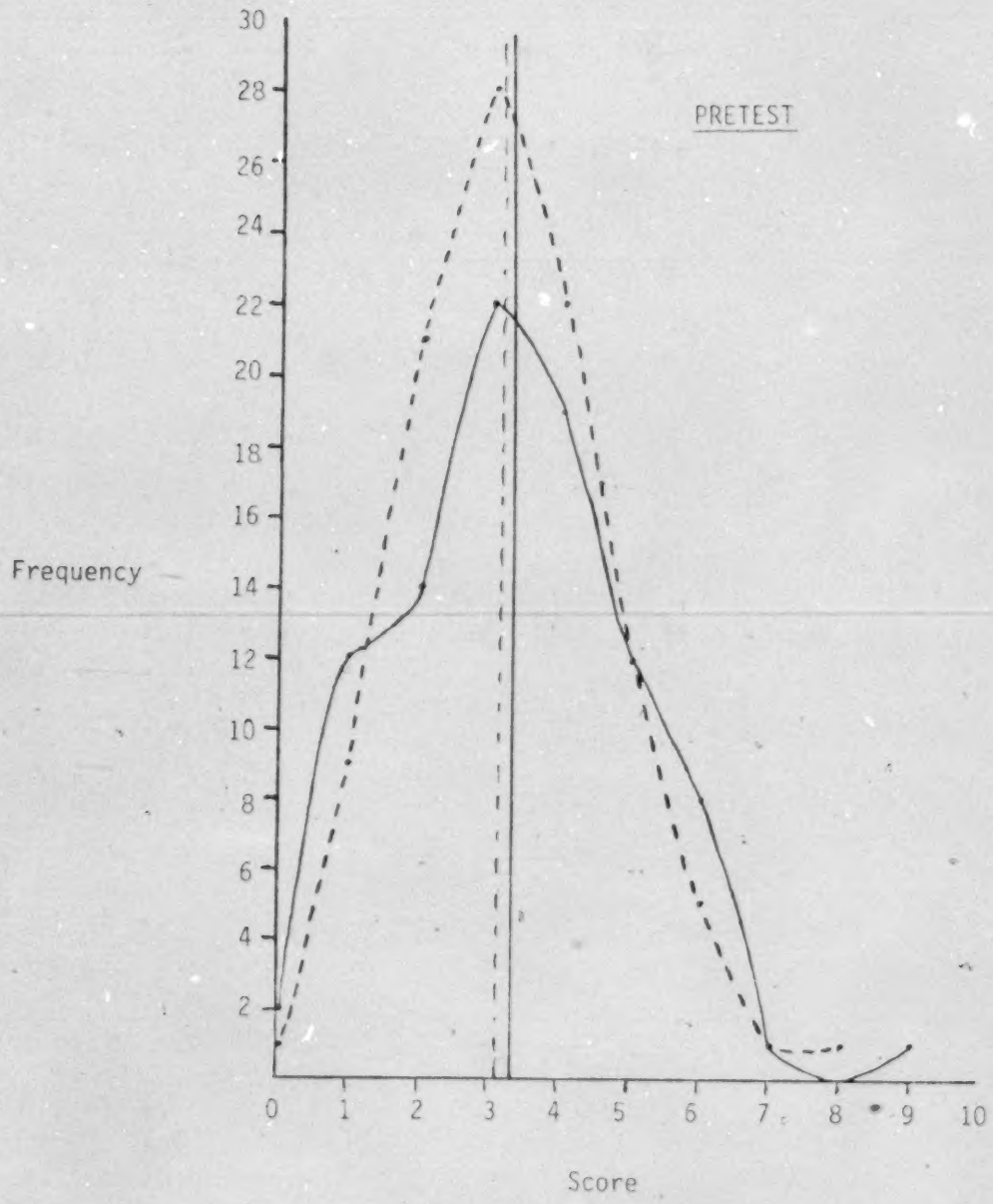
Post-Test

	N	Mean	SD	SD^{2**}	*t****
Control #1	92	10.24	2.47	6.18	1.86
Experimental #II	100	9.57	2.50		

* *t*.05=1.98 (Ferguson, pg. 171)
** Unbiased Estimate of Variance (Ferguson, Pg. 167)
*** *t*.05=1.96

TABLE 4

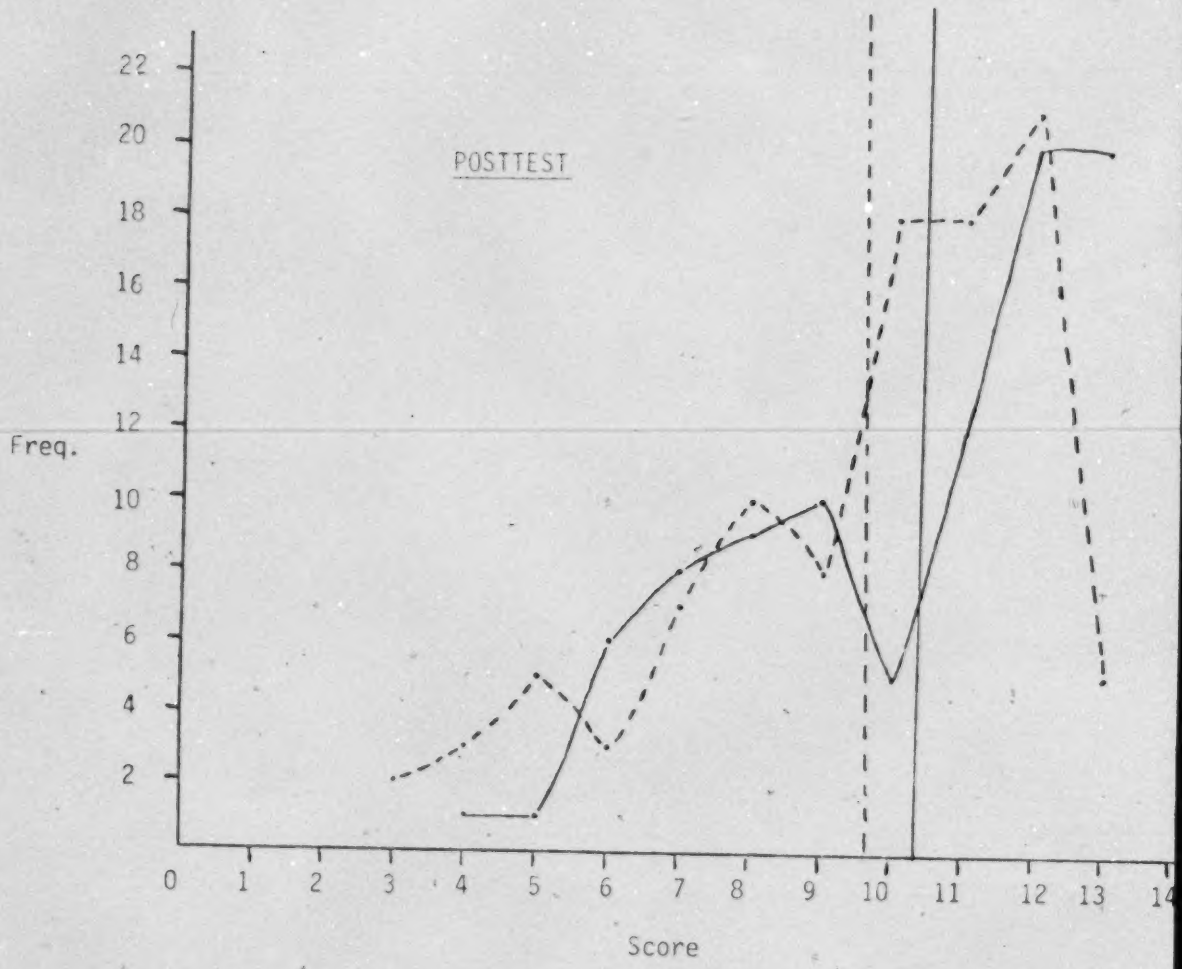
FREQUENCY POLYGONS



Control Group _____

Experimental Group - - - - - - - -

TABLE 5



Control Group _____

Experimental Group - - - - - -

TABLE 6

SIGN TEST FOR TWO INDEPENDENT SAMPLES*

Median of the control group + experimental group observations = 9.8.

	+	-	
Control	57	35	92
Experimental	62	38	100
	119	73	

$$\chi^2 = \frac{192(57 \times 38 - 35 \times 62)^2}{92 \times 100 \times 119 \times 73} = \frac{3072}{79920400} = .0000384$$

$df = 1$

$\chi^2_{.05}$ not significant

* Ferguson, pg. 355

TABLE 7

GAIN/LOSS

Pre- to Post-Test

Group	N	Pre-Test Mean (RAW)	Per Cent Correct	Post-Test Mean (Raw)	Per Cent Correct	% Gain/Loss Pre- to Post-Test
Control I	92	3.42	26	10.24	79	203*
Experimental II	100	3.28	25	9.57	74	196**

* Printed Criterion Test Questionnaire
** Filmed Criterion Test Questionnaire

APPENDIX A

OBA Film MN-31169

Criterion Test Items

QUIZ

1. The Oxygen Breathing Apparatus Type A-3 is used for:

   A. Protection against heat and fire.
   B. Protection against biological and chemical agents.
   C. Protection against smoke and similar irritants.
   D. Protection in underwater environment

2. The Oxygen Breathing Apparatus Type A-3 uses the following source of oxygen:

   A. Bottled oxygen.
   B. Compressed Air Tank.
   C. Oxygen Generating Canister.
   D. Air filter system.

3. The OBA Type A-3 system is put into operation by:

   A. Opening oxygen tank valve.
   B. Inserting gas filter and starting timer.
   C. Energizing air compressor.
   D. Pulling quick-start lanyard.

4. The oxygen produced by the OBA system is cooled by:

   A. A metal heat exchanger.
   B. No special means.
   C. The flow of oxygen through a breathing bag.
   D. A chemical process.

5. The OBA provides oxygen by:

   A. An oxygen generating chemical reaction.
   B. A pressurized oxygen supply system.
   C. Breakdown of surrounding air.
   D. None of the above.

6. A man wearing the OBA in a smoke environment hears the timer sound What must he do to get a resupply of oxygen?

   A. Quickly exchange tanks.
   B. Use the buddy system.
   C. Switch to the reserve supply.
   D. Go to fresh air environment for resupply.

7. The eyepieces in the OBA facepiece are kept clear of fogging by:

   A. Special antifog chemicals in the system.
   B. Thermal glass.
   C. Air flow only.
   D. Air drying filter.

8. When the OBA nears the end of its supply of oxygen, the wearer wi notice:

   A. A smell of smoke or irritants in the facepiece.
   B. A red colored signal in the flow meter.
   C. Eyepiece fogging and difficulty in breathing.
   D. Collapse of air breathing tubes.

One of the possible hazards relating to the OBA is:

A. The handling and disposal of caustic canister chemicals.
B. The overheating of charcoal filters.
C. The rupturing of the oxygen pressure line.
D. Inoperative flow meter.

0. The OBA is designed to supply oxygen for a period of approximately:

A. 10 to 20 minutes.
B. 45 to 60 minutes.
C. 90 to 120 minutes.
D. 3 hours.

1. In order to manually start the OBA system, the wearer must:

A. Open the oxygen valve.
B. Use own breath to fill the system.
C. Connect the compressor line.
D. Bypass the filter pack.

2. The OBA can present a hazard if the oxygen supply comes in contact with:

A. Oil.
B. Water.
C. Foam.
D. A hot surface.

3. The OBA is a reliable system; however, the system will fail to functi if:

A. The canister is inserted backwards.
B. The oxygen valve is closed.
C. The heat exchanger overheats.
D. The flow meter is in the off position.

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The results of this study revealed no significant differences which can be accounted for, in test scores of subjects divided into two groups--control and experimental--which were tested by two distinct methods (printed questionnaire vs. film projected questions). A serendipitous finding revealed that learning gains were quite outstanding when comparing student pre- and post-test differences. Recommendations suggest that film type

training packages can be judiciously prepared for various informal training environments as well as formal classroom instructional settings.